for existence among the branches of a tree, and some of them must perish; the destruction of these branches, therefore, must conduce to the betterment of those that remain.

Most fruit-growers advise early and continuous pruning as a means of saving time, and also to direct the energy of the tree which is put forth to produce these superfluous branches into those which are to remain. Professor Bailey believes that annual pruning is desirable, but he is equally convinced that it does not pay, either in cost of pruning or in good to the tree, to cut out all superfluous branches at each pruning. These twigs can often be left till three or four years old with advantage. Pruning in itself cannot be injurious so long as it does not interfere with the nutrition of the plant. Eight reasons are given why pruning should be done.

Part II treats more of the details of everyday practice in starting and shaping the heads of plants; and here the reader is urged to bear in mind the distinction between training or trimming the plant into some desired form, and pruning for definite results in the welfare of the plant and in fruit-bearing.

In discussing the subject of root-pruning the so-called Stringfellow system of stub-root pruning is compared with the ordinary method. Results obtained by the author at the Cornell Experiment Station proved that trees moderately root-pruned were clearly the best. Others, however, have had good results from the Stringfellow method, all of which shows that this method is to be considered a matter of local practice and not a matter of general principle.

The closing chapters of the book treat of training American grapes. The various methods are fully discussed and illustrated, thereby making this one of the most valuable features of the book, especially to the American grape-grower.—J. TROOP.

Fossil botany.

BOTANISTS and geologists both are bound to welcome Professor Seward's work on fossil plants, the first volume of which has recently appeared.[2] This book forms one of the familiar Cambridge "Natural Science Manuals," and is rather more extensive than the others. It is surely safe to say that no general work on paleobotany had yet appeared in English that is satisfactory to both botanists and geologists, and very few that are satisfactory to either. Thus it is a pleasure to read in the preface that this book is intended for both botanists and geologists, and hence has to be adapted to both non-geologists and non-botanists, since it is unfortunately true that neither class as a

[2] SEWARD, A. C.: Fossil plants for students of botany and geology. Vol. I. pp. 450, with illustrations. Cambridge: University Press. 1898.

rule appreciates the standpoint of the other. The first chapter contains a brief historical sketch of paleobotany, in which the author gives special credit to Brongniart and Williamson. Chapter two gives the relation of the subject to botany and geology. Professor Seward tells how paleobotany has been buffeted about by the geologist and the botanist, the one culling out facts relating to the correlation of strata, the other caring only for facts which give hints as to phylogeny and evolution. He pleads for the recognition of paleobotany as a science of and for itself, with its own peculiar problems, viz., the determination of the historical succession of plants in geological time; the delineation of the actual evolution of the plant kingdom, giving light on phylogenetic mysteries; the presentation of the various floral areas of the past, leading up to an explanation of the distribution of plants in the present day; conclusions as to climatic and other conditions in geological time, as revealed by the occurrence of certain peculiar plant types and by anatomical adaptations to environment.

The third chapter gives the leading facts of geological history and is designed for botanical readers.

The next chapter discusses the various methods for the preservation of plants as fossils; structure unmodified, as in fossil soils and forests; carbonization; incrustation, as travertine; casts; petrifactions. The relative rarity of plant fossils is due to their soft structure and land habitats. Chapter five is exceedingly interesting and valuable, as it demonstrates the enormous difficulties and sources of error, such as (1) the danger of depending too much on external resemblances, since many forms from algæ up to seed plants may look alike, even in modern forms, much more in fossils; (2) fragmental preservation (this is much more common than in animal fossils, and also leads to much more error, since a plant often can be identified only in fruit); (3) the decorticated trunks and pith cylinders; (4) resemblance to animals or animal tracks and mineral deposits.

After a chapter on nomenclature, the author takes up the plants by groups. In this first volume he treats only of the thallophytes, bryophytes, and some pteridophytes. Among the algæ there is an abundance of undoubted fossil blue-green algæ, forming deposits of travertine and possibly oolite; Professor Seward thinks that similar forms probably represented the first life of the Algonkian. Because of their siliceous tests there are vast deposits of diatoms, mainly from the Cretaceous on. Of the larger marine algæ those forms are especially preserved which are covered during life by calcareous incrustations, especially the corallines. Many plants of all kinds and many mineral deposits, rill marks, and animal tracks have been referred to the algæ, and especially to the fucoids. Among the fungi there are abundant evidences of fossil bacteria, but the higher forms are rare, though found in the Carboniferous and Tertiary. The liverworts and mosses are poorly preserved and difficult to identify. Of the pteridophytes, the author

considers in this volume only the Equisetales and Sphenophyllales. Both of these groups are abundantly preserved and well known. At the close of the volume is an excellent bibliography.

This work has at least three features to commend it that are by no means common to all books on paleobotany. It is extremely cautious in its statements; many forms commonly described are either classified tentatively or omitted altogether; there are not so many startling allusions to high grade plants in the early ages, but there are more real facts on which to base safe conclusions. Another valuable feature of the book is that important facts have been culled out from a mass of unimportant material, and by no means least in its commendable qualities is that it is actually readable; even the botanical or geological layman may enjoy it, if he cares for such things at all. Everyone who reads the first volume will anxiously await the appearance of the second.—HENRY C. COWLES.

MINOR NOTICES.

DR. L. M. UNDERWOOD read a wise and vigorous paper on the study of botany in high schools before the New York Science Teachers' Association last December. Copies from the *Journal of Pedagogy* for April have been distributed.

DR. W. F. GANONG published in this journal seven years ago (May 1891) a brief account of the raised peat bogs of New Brunswick. During the summers of 1895 and 1896 he was able to give these additional study, and has now published a much more complete and detailed description of the ecological and physical features of these interesting areas.[3]—C. R. B.

TWO BULLETINS of the U. S. Forestry Division have recently been issued.

Bulletin no. 15 is by F. V. Coville, on "Forest growth and sheep grazing in the Cascade mountains of Oregon." It furnishes an account of the methods of sheep grazing on the government reservations in the region named, and their relation to forest preservation both from overgrazing and from fires. Under recent legislation the Interior Department is empowered to make regulations governing grazing on public lands. This report suggests an equitable and apparently feasible system.

Bulletin no. 16 discusses the "Forestry conditions and interests of Wisconsin." It presents the information acquired by Mr. Filibert Roth, a special agent of the department, who made a forest census under the auspices of the state forestry commission and the natural history survey. Botanists will be glad to know that Wisconsin is awakening to an interest in rational forest management. The recommendations of Dr. Fernow, based upon the infor-

[3] Transactions of the Royal Society of Canada II. **2**: 131–163. *figs. 11.* 1897.